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Investment Horizon, Risk and Return in Commodity Futures Markets

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ABSTRACT

The purpose of this paper is to apply the market model to 42 selected commodity future contracts from 1972-1977 in order to test the relationship between investment horizon and alternative risk-return measures, to describe the probability distribution of price changes in futures over different interval lengths, and to explore the sensitivity of the results to alternative measures of wealth.

Investment Horizon, Risk, and Return in Commodity Futures Markets

I. Introduction

The nature of risk and returns and how to measure them in investment markets has been discussed for many years. Regarding commodity futures markets, Keynes first proposed that speculators earned a risk premium as their reward for absorbing hedger's risks. Gray could not find the suggested price biases required to support Keynes' underlying hypothesis. Rockwell measured rates of return for groups of traders in commodity futures markets with semi-monthly data, but did not examine risks. Futures contracts have long been recognized for their ability to transfer risk from hedgers to speculators, but little is known about the risk and return patterns for speculators.

Considerable methodological advancement has been made in the last 15 years with respect to identifying, measuring and determining risk and and returns. Best known for its development and empirical use are the Sharpe (1963) single index model (market model) and the capital asset pricing model (CAPM) developed by Sharpe (1964) and Lintner. These models will determine to what extent variations in individual rates of return are systematically related to variations in market rates of return. The CAPM or Sharpe's single index model can be used to decompose total risk into systematic and unsystematic risk components. These models have been applied to such securities as stocks, bonds, options and mutual funds, but to date the only known applications to commodity futures markets are (Dusak and Bodie and Rosansky).

Dusak estimated systematic risk for a sample of semi-monthly prices of wheat, corn, and soybean futures contracts, 1952-1967, and found it to

be close to zero in all cases. Average realized returns were also close to zero. However, these results may be nonrepresentative because many traders in commodity futures markets have very short-run investment horizons. Semi-monthly data may not capture the true nature of the risk and return relationship that they face. Bodie and Rosansky also found systematic risk near zero for 23 commodities over a 27-year period, but holding period returns were strongly positive. However, their results are based on quarterly data, or 3-month holding periods, which far exceeds average investment horizons. When examining commission house records, Ross found that 52 percent of the trades were held less than seven days. Only 30 percent were held 15 or more days. Since these data did not include floor traders who usually have investment horizons shorter than one day, the average length a contract is held is undoubtedly shorter than that reported by Ross. Trade experts sometimes talk of an average holding period of three days. Hence, using data for periods longer than one day may give misleading risk-return relationships.

Recently, several analysts have examined the relationship between investment horizon and measures of risk and returns. Cheng and Deets (1971) discussed the statistical biases associated with security rates of return estimates. Levhari and Levy point out the disparities when arbitrarily using data for a period which is different from the "true" horizon. Blume derived some unbiased estimators of long-run expected rates of return. These authors all demonstrate the importance of the impact of investment horizon on the estimate of expected rates of return. Empirical investigations of this for common stock have been done by Cheng and Deets (1973), Levhari and Levy, Lee and Morimune, Lee, and others.

In addition, skewness or kurtosis in the distribution of returns may vary with investment horizon. The shape of the return distribution could be used as a criteria for determining the appropriateness of an investment horizon. For example, Hagerman has shown that the distribution of stock market rates of return is not independent of changes in time horizon, while Folger and Radcliff have found the degree of skewness for stock market rates of return is not independent of investment horizon. Such relationships in commodity futures markets are not known.

Another potential source of bias of the coefficients reported by Dusak and Bodie and Rosansky is the use of the Standard and Poor (S&P) Composite Index of 500 industrial common stocks as a proxy for the return on total wealth. Ideally, an index with stocks, bonds, options, commodity futures contracts, real estate and all other investment sources would be desired for the true measure of return on total wealth. However, since no perfect index exists, proxies must be ued, and results may be quite sensitive to the proxy selected. In applying the CAPM to cash commodities, Holthausen and Hughes found strikingly different results depending upon whether they used a stock market index or a commodities index. However, their results are based on monthly observations.

The purpose of this paper is to apply the market model to 42 selected commodity futures contracts from 1972-1977 in order to test the relationship between investment horizon and alternative risk-return measures, tko describe the probability distribution of price changes in futures over different interval lengths, and to explore the sensitivity of the results to alternative measures of wealth. We do this by using daily futures prices, varying investment

horizons from 1 to 22 days, and using both a stock price index and commodity price index. Since a proxy for daily risk-free rates of return is difficult to obtain, the market model instead of the CAPM is used in this empirical study.

The data used in this study are described in the second section. The third section explores the relationship between horizon and each of the first four moments of the rates of return. In the fourth section, rates of return for the commodity futures contracts are regressed against each of the two indexes as risk is decomposed in each contract. The fifth section tests the risk-return trade-offs, and the results of the paper are summarized in the final section with possible future research indicated.

II. The Data

The stock index used in this paper is the Standard and Poor Composite Index of 500 industrial common stocks. The commodity futures index is based on 27 commodities and is constructed by the Commodity Research Bureau, Inc. The 42 individual contracts analyzed are the December corn, wheat, hogs, and cattle contracts, and the November soybean contract, all for 1972-1977. Since there is no corresponding year-ending contract for pork bellies, the following February contract was selected for analysis. Thus in the tables presented below, the results for pork bellies under any given calendar year refer to the February contract maturing the following year (for example, under 1973 will be results for the February 1974 pork belly contract). Also analyzed are the December gold (International Monetary Market), silver (Chicago Board of Trade), and Treasury Bill (International Monetary Market) contracts for 1976-1977. Since the

contracts for differing maturities of one commodity usually fluctuate fairly close together, using one contract per commodity within a year is sufficient for analysis. The above commodities also represent the most actively traded commodity futures contracts and provide an ample cross section of alternative investment possibilities.

Most contracts trade for about one year, although the exact dates for trading vary among commodities. Table 1 lists the number of observations for each of the 42 contracts analyzed.

Commodity futures contracts are highly leveraged. Typically an investor needs to post only about 10 percent of the value of the contract. As is becoming commonly accepted, and argued by Dusak, from a general equilibrium point of view the spot commodity is the relevant asset. However, spot price data are not readily accessible, and in some cases involve estimating and discounting for storage costs. Also, the degree of leverage cannot be measured on an individual basis. Thus, for computational convenience we utilize futures prices, and measure returns as percentage changes in unleveraged contract values. Leveraged returns would exceed those reported here by about a factor of 10. Both discrete (arithmetic) and continuous (logarithmic) rates of return are calculated and analyzed. The average logarithmic rates of return will be slightly smaller than the average arithmetic rates of return. However, the results are so similar that we present only the arithmetic results.

Many professional traders do not hold positions overnight. Those data are not available to us, but the techniques developed here could be applied to transaction-by-transaction data. We chose a 22-day horizon

Table 1. Number of Observations in Each Contract Analyzed

Commodity	1972	1973	1974	1975	1976	1977
Wheat	242	240	243	301	244	304
Corn	244	306	323	312	303	304
Soybeans	224	285	302	289	285	276
Hogs	239	282	303	287	279	329
Cattle	240	258	243	246	209	290
Pork Bellies	282	236	364	316	236	301
Gold					358	366
Silver					349	373
Treasury Bills					244	373

as the maximum since that is approximately the number of trading days in one calendar month. Due to limited computer funds and similarity of results over horizons, we report individual commodity results only for horizons of 1-10, 15, 16, 21, and 22 days.

III. Statistical Distributions of 42 Individual Futures Contracts and Their Time-Moment Relationships

Rates of return, both discrete and continuous, were computed for each of the 42 futures contracts for each of the above 14 horizons. For the ith horizon, returns are computed by the formulation $(P_{t+i} - P_t)/P_t$. The horizons exceeding one day are nonoverlapping. These returns are for the "long" side of the market, those who buy and hold futures contracts. An investor maintaining a "short" position in the futures market would have the negative of the return calculated for the "long". Commissions and other trading costs are ignored in this analysis.

For each of the 588 combinations of contract and investment horizon, the average rate of return, the standard deviation, coefficient of variation, skewness, and kurtosis were estimated. Individual results will not be presented. Rather, the relationship of each moment with respect to time will be discussed.

First, tests were conducted on the skewness and kurtosis coefficients to determine whether rates of return are normally distributed. The formulas are: Skewness = Mom 3/(cubed standard deviation), and Kurtosis = Mom 4/(squared variance). The standard errors used to test the coefficients are (Snedecoran and Cochran):

$$S_1 = [6n(n-1)/(n-2)(n+1)(n+3)]^{1/2} \tag{1}$$

$$S_2 = [z4n(n-1)^2/(n-3)(n-2)(n+3)(n+5)]^{1/2} \tag{2}$$

where S_1 is the standard error for skewness, S_2 is the standard error for kurtosis, and n is sample size. There is no apparent pattern to the percentage of skewness and kurtosis coefficients by commodity and horizon which are significantly different from zero at the 95 percent level of confidence, except that rates of return are more likely to be normally distributed at the longer horizons. Overall, 16 percent of the skewness coefficients and 18 percent of the kurtosis coefficients are significantly different from zero. Thus, the vast majority of commodity rates of return over alternative horizons are normally distributed, indicating standard statistical tests can be conducted.

To investigate time-moment relationships of the first four moments and the coefficient of variation for the each of the 42 futures contracts, the following relationship is defined:

$$Y_{ijT} = a_i + b_i T \qquad i = 1, \ldots, 5 \tag{3}$$

where Y_{ijT} is represented by $\overline{R}_{jT}$ for average rates of return, SD_{jT} for standard deviation of returns, CV_{jT} for the coefficient of variation of returns, SK_{jT} for skewness of returns, K_{jT} for kurtosis of returns, all for the jth contracts and the Tth horizon, and T = investment horizons for 1,..., 10, 15, 16, 21, 22.

The slope coefficients for the average rate of return are presented in Table 2. All of the mean rate of return slope coefficients, as well as all of the standard deviation slope coefficients and all but 5 of the

Table 2. Slope Coefficient for Time-Moment Relationship--
Mean Rate of Return $(\overline{R}_T = a + bT)$

Commodity	Year 1972	1973	1974	1975	1976	1977
Wheat	.00231* (.00006)[a]	.00416* (.00007)	.00030* (.00008)	-.00123* (.00003)	-.00122* (.00004)	-.00054* (.00003)
Corn	.00080* (.00013)	.00254* (.00008)	.00200* (.00002)	-.00068* (.00003)	-.00048* (.00002)	-.00058* (.00002)
Soybeans	.00090* (.00005)	.00240* (.00006)	.00128* (.00006)	-.00160* (.00002)	.00072* (.00008)	-.00011* (.00004)
Hogs	.00089* (.00005)	.00254* (.00008)	.00039* (.00004)	.00069* (.00007)	-.00053* (.00009)	.00051* (.00005)
Cattle	.00059* (.00008)	.00048* (.00009)	-.00087* (.00004)	.00073* (.00002)	-.00018* (.00004)	-.00026* (.00004)
Pork Bellies	.00117* (.00005)	.00127* (.00006)	.00063* (.00003)	.00066* (.00002)	-.00064* (.00004)	.00026* (.00004)
Gold					-.00077* (.00002)	.00069* (.00004)
Silver					-.00085* (.00001)	-.00030* (.00002)
Treasury Bills					.00008* (.00000)	.00007* (.00000)

[a]The standard error is in parenthesis.

*Significantly different from zero at the 95 percent level of confidence.

coefficient of variation slope coefficients, are significantly different from zero. This means that the change in these descriptive statistics is significantly related to the change in investment horizon.

Table 2 indicates that 26 contracts are positively related to the change in horizon while 16 contracts are negatively related. A positive (negative) relationship implies that the average rate of return increases (decreases) with respect to an increase in investment horizon. The sign reflects the trend of that particular contract from the "long" side, while the significance reflects the relationship with investment horizon. That is, the mean rates of return in all cases are not independent of horizon, and positive (negative) coefficients reflect generally rising (falling) prices during the life of the contract. All of the coefficients for 1972 and 1973 and all but cattle for 1974 have positive relationships. The results are mixed for 1975, 1976 and 1977 in terms of sign. These results conform to those given by Bodie and Rosansky where rates of return for commodity futures in general were strongly positive in 1972, 1973 and 1974, slightly negative in 1975, and slightly positive in 1976. The reader is reminded that our rates of return are for unlevered contracts.

All the slope coefficients for the standard deviations regressed against time are positive, meaning standard deviation increases with increased investment horizon. The signs for the significant coefficient of variation slopes are opposite of those in Table 2 for the average rates of return. Of the 5 slopes which are insignificant, individual mean returns are near zero, sometimes alternating sign over horizon, thereby influencing the magnitude of the coefficient of variation.

Further investigation of these results showed that mean returns always increase (in absolute value) faster than the standard deviation as horizon increases. Thus, an increase in the holding period can improve investment performance providing one is on the "right" side of the market, i.e., long as prices rise and short when prices fall.

Finally, only 13 of the 42 futures contracts have skewness significantly related to investment horizon, while kurtosis and investment horizon are significantly related in 21 cases. For the most part, if skewness of a contract is related to horizon, kurtosis of the contract is not related and vice-versa. Thus, as opposed to the first two moments, the 3rd and 4th moments are largely independent of horizon. The shape of the distribution of rates of return does not appear to change significantly as horizon is changed.

IV. Systematic Risk and Non-systematic Risk Decomposition for 42 Individual Futures Contracts

Based upon the theory and concepts of the market model developed by Sharpe (1963), and Fama, the rates of return of the 42 individual commodity futures contracts are regressed on stock market index and the commodity futures index. The regression models are defined as:

$$R_{jt} = \alpha + \beta_s R_{mt} + E_{jt} \tag{4}$$

$$R_{jt} = \alpha + \beta_c R_{ct} + E_{jt} \tag{5}$$

where R_{jt} = rates of return for jth futures contract in period t,

R_{mt} = stock market (S&P) rates of return in period t,

R_{ct} = futures market (CFI) rates of return in period t.

Since there are 588 contract-horizon combinations, only summaries will be presented. Table 3 indicates the number of β_c coefficients significantly different from zero while Table 4 indicates the number of β_s coefficients significantly different from zero. These results show that rates of return of individual futures contracts are strongly related to the rates of return of the CFI; however, the rates of return of individual futures contracts are generally not significantly related to rates of return of S&P.

Table 3 indicates that β_c for corn is always significantly different from zero, regardless of horizon. However, gold has less than half of the β_c coefficients significant, and none are significant for Treasury Bills. These latter results probably reflect the "agricultural" bias to the CFI and that these commodities are countercyclical to agricultural prices. Interesting, however, is that most of the silver β_c coefficients are significant. Finally, 1972 stands out as a year of relatively less significant β_c coefficients in Table 3, although the reason is not clear.

Table 4 shows that most of the β_s coefficients are not significantly different from zero. The only unusual result is for soybeans, 1972 where 10 of the 14 horizons are significant.

As a means of further evaluation, equations (4-5) were combined into a multiple regression equation where the rate of return was regressed on both indexes at the same time. The results were virtually identical to those in Tables 3 and 4. Over 80 percent of the β_c coefficients were significant and substantially less than 10 percent of the β_s coefficients were significant. There was also a distinct trend for the R^2 to increase as horizon incrased for any given contract.

Table 3. Number of β_c Coefficients Significant (.05 level) Over 14 Alternative Horizons (1,2,...,10,15,16,21,22)

	Year					
Commodity	1972	1973	1974	1975	1976	1977
Wheat	13	10	14	14	14	13
Corn	14	14	14	14	14	14
Soybeans	10	14	14	14	14	14
Hogs	7	14	14	10	14	14
Cattle	9	14	14	11	6	14
Port Bellies	4	11	13	10	13	9
Gold					4	8
Silver					12	14
Treasury Bills					0	0

Table 4. Number of β_s Coefficients Significant (.05 level) Over 14 Alternative Horizons (1,2,...,10,15,16,21,22)

	Year					
Commodity	1972	1973	1974	1975	1976	1977
Wheat	1	0	0	0	0	0
Corn	1	0	0	0	0	0
Soybeans	10	1	2	0	0	0
Hogs	3	0	0	1	1	0
Cattle	1	0	0	0	4	0
Pork Bellies	0	0	1	0	0	0
Gold					0	0
Silver					0	1
Treasury Bills					0	4

These results show that commodity futures contracts have a high degree of systematic risk relative to the CFI, but mostly unsystematic risk with respect to S&P. So for a portfolio consisting of common stocks, commodity futures contracts would provide diversification and would be attractive to the investor. On the other hand, an investor with a portfolio of commodity futures contracts would probably not want to add more nondiversifiable futures contracts to the portfolio, except for gold and Treasury Bills.

These latter results support in part those of Dusak who found little to no systematic risk between commodity futures contracts and the stock index. Most of the β coefficients in Bodie and Rosansky were also insignificant. They confirm Holthausen and Hughes findings that the β coefficients are very sensitive to the market index selected. Unfortunately, an overall wealth index does not exist.

In order to see the relative magnitudes of the various β coefficients, Tables 5 and 6 present the average β_c and β_s over horizons, respectively, while Table 7 shows both coefficients across commodity for each horizon.

In Table 5 almost all of the β_c coefficients for the grains (wheat, corn, and soybeans) are greater than 1.0, meaning those commodities have been more volatile than the futures market as a whole. Conversely, most of the meat product (cattle, hogs, and pork bellies) β_c coefficients are less than 1.0, but greater than zero. These commodities have been less volatile than the market as a whole. The gold and silver coefficients are between zero and 1.0, but the Treasury Bill coefficients are very small and negative.

Table 5. Average β_c Over Horizons

Commodity	Year 1972	1973	1974	1975	1976	1977
Wheat	1.666 (.257)[a]	1.165 (.262)	1.344 (.133)	1.542 (.074)	1.465 (.135)	.926 (.111)
Corn	1.573 (.286)	1.522 (.155)	1.417 (.078)	1.259 (.071)	.900 (.127)	1.110 (.093)
Soybeans	.767 (.418)	1.888 (.237)	1.686 (.309)	1.554 (.113)	1.988 (.169)	1.889 (2.15)
Hogs	.610 (.174)	1.007 (.223)	1.507 (.322)	.781 (.171)	1.097 (.164)	.952 (.151)
Cattle	.758 (.203)	.689 (.289)	1.100 (.290)	.648 (.121)	.590 (.138)	.631 (.089)
Pork Bellies	.542 (.289)	.867 (.224)	1.286 (.180)	.954 (.163)	1.474 (.183)	.878 (.246)
Gold					.289 (.137)	.635 (.129)
Silver					.973 (.212)	.652 (.077)
Treasury Bills					-.008 (.018)	-.001 (.023)

[a] The standard deviation is in parenthesis.

Table 6 shows that most of the β_s coefficients are small in value with a high proportion of them negative. Note that the respective standard deviations in Tables 5 and 6 are quite similar in magnitude, and if anything, slightly larger for the β_s coefficients.

Table 7 shows the β_s coefficients when measured across commodities to be very small for all horizons, and all negative beyond the 4-day horizon. The β_c coefficients are all slightly larger than 1.0 and very similar in magnitude regardless of the horizon. Thus, the β_c coefficients show no sensitivity to horizon, while the β_s coefficients, all small in magnitude, show decreasing systematic risk with respect to S&P over horizon.

To investigate the time-variance relationships for β_c and β_s, 42 regressions were run in acccrdance with the following two equations:

$$\beta_{cT} = a_1 + b_1T \tag{6}$$

$$\beta_{sT} = a_2 + b_2T \; . \tag{7}$$

The results demonstrate that there exists some relationship between the magnitude of β_c and β_s and investment horizon, although less than half of the coefficients are significant and the significant ones are scattered across commodities and years. As expected from the previous set of tables, most of the slope coefficients for the β_{sT} regression (Equation 7) are negative. Thus, there is not a strong relationship between the size of the β coefficient, indicating systematic risk, and investment horizon. Indpendence between the two most often exists.

Table 6. Average β_s Over Horizons

Commodity	Year 1972	1973	1974	1975	1976	1977
Wheat	.487 (.334)[a]	-.199 (.348)	.080 (.158)	-.279 (.142)	.267 (.180)	.207 (.156)
Corn	.085 (.223)	-.080 (.259)	-.145 (.133)	-.150 (.270)	.106 (.131)	.064 (.184)
Soybeans	.474 (.180)	.171 (.811)	-.027 (.244)	-.305 (.338)	-.101 (.123)	.148 (.362)
Hogs	-.521 (.199)	.049 (.235)	-.000 (.160)	-.294 (.288)	.138 (.376)	-.158 (.236)
Cattle	-.423 (.405)	.173 (.295)	-.150 (.179)	-.302 (.226)	-.681 (.438)	-.092 (.078)
Pork Bellies	-.472 (.279)	-.138 (.441)	.032 (.208)	-.310 (.336)	-.297 (.675)	-.260 (.252)
Gold					-.016 (.162)	-.102 (.415)
Silver					.061 (.350)	.060 (.239)
Treasury Bills					.019 (.017)	.037 (.026)

[a]The standard deviation is in parenthesis.

Table 7. Average β Across Commodities for Each Horizon

Horizon (Days)	β for Stocks	β for Commodities
1	.041 (.132)[a]	1.028 (.476)
2	.012 (.151)	1.018 (.454)
3	.013 (.186)	1.060 (.474)
4	.017 (.240)	1.051 (.449)
5	-.033 (.203)	1.067 (.445)
6	-.046 (.267)	1.048 (.468)
7	-.037 (.306)	1.055 (.486)
8	-.067 (.362)	1.057 (.526)
9	-.124 (.307)	1.041 (.551)
10	-.137 (.312)	1.057 (.516)
15	-.152 (.514)	1.095 (.539)
16	-.157 (.590)	1.077 (.557)
21	-.101 (.604)	1.071 (.591)
22	-.260 (.619)	1.133 (.641)

[a]The standard deviation is in parenthesis.

V. Risk-Return Trade-off Test

In the introduction section, the importance of testing the existence of a risk premium (in a total risk sense) for the commodity futures contracts was explored. Alternative cross-sectional models used to test this are:

$$\overline{R}_j = a_1 + b_1\sigma_j \tag{8}$$

$$\overline{R}_j = a_2 + b_2\beta_s \tag{9}$$

$$\overline{R}_j = a_3 + b_3\beta_c \tag{10}$$

where $\overline{R}_j$ = average rate of return for the jth contract

σ_j = standard deviation for the jth contract

β_s, β_c as previously defined.

The empirical results for Equations (8-10) using 42 contracts for observations are presented for 14 alternative horizons in Table 8. There does not exist any relationship between average rates of return and the estimated β_s and β_c except for β_s at the 22-day horizon. However, there exists a significant positive relationship between $\overline{R}_j$ and σ_j for all horizons except 1, 4, and 7-day horizons. These results imply that there may exist a risk premium for commodity futures contracts if the total risk instead of the systematic risk measure is used. However, this analysis does not shed any light on the normal backwardation hypothesis since we did not adjust futures prices for the rise in cash prices (Gray). Also, this analysis identifies only ex-post risk-return tradeoffs.

Most recently, Levy has shown that the CAPM is not necessarily an applicable tool for decomposing the total risk into systematic and

Table 8. Results of Regressing Mean Rate of Return on Selected Variables in Analyzing Risk-Return Trade-Offs

Horizon (Days)	Standard Deviation Coefficient	R^2	β for Stock Index Coefficient	R^2	β for Commodity Index Coefficient	R^2
1	.0494 (.0294)a	.07	.0000 (.0014)	.00	.0003 (.00004)	.01
2	.0964* (.0380)	.14	.0002 (.0024)	.00	.0008 (.0008)	.03
3	.1040* (.0461)	.11	.0005 (.0029)	.00	.0011 (.0011)	.02
4	.1004 (.0547)	.08	.0023 (.0029)	.02	.0009 (.0016)	.01
5	.1317* (.0578)	.11	-.0005 (.0044)	.00	.0018 (.0020)	.02
6	.1342* (.0604)	.11	-.0012 (.0040)	.00	.0014 (.0023)	.01
7	.1242 (.0651)	.08	.0024 (.0041)	.01	0008 (.0026)	.00
8	.1814* (.0645)	.17	-.0007 (.0040)	.00	.0025 (.0027)	.02
9	.1844* (.0661)	.16	-.0007 (.0053)	.00	.0026 (.0030)	.02
10	.2088* (.0662)	.20	-.0026 (.0058)	.01	.0046 (.0035)	.04
15	.2824* (.0780)	.25	.0006 (.0054)	.00	.0013 (.0051)	.00
16	.2597* (.0737)	.24	.0076 (.0049)	.06	.0079 (.0052)	.06
21	.2292* (.0909)	.14	.0085 (.0061)	.05	.0046 (.0063)	.01
22	.3218* (.0736)	.32	-.0154* (.0063)	.13	.0096 (.0064)	.05

[a]The standard error is in parenthesis.

*Significantly different from zero at the 95 percent level of confidence.

non-systematic risk unless some strong assumptions are held. One of these assumptions is that the security should be widely held by investors. If the security is held by only a small group of investors, then the market rates of return obtained from an overall index (e.g., S&P) will be subject to measurement error and the estimated beta will be downward biased. As futures contracts are not widely held, the market rates of return calculated from the S&P index will likely be inappropriate. Nevertheless, results in this section have shed light on the usefulness of the market model, or CAPM, and the importance of investment horizon in determining the risk-return relationship of commodity futures contracts.

VI. Conclusions

Futures markets are widely recognized as a means for transferring risks through hedging. This paper reports the investigation of the risk-return relationships among 42 futures contracts and the impact of investment horizon. Daily data on contracts from 1972-77 are used in the analysis.

The mean rates of return depend upon the direction of the price moves during the life of the contract, and they were positive for all but one contract during 1972-74. Results for 1975-77 were mixed with regard to sign. However, all rates of return became larger (in absolute value) as horizon increased, showing returns were not independent of horizon. Standard deviations, also grew, but at a slower rate than did the means, indicating investment performance improved as horizon increased, as long as one was on the "right" side of the market. The shape of distributions of rates of return seemed largely independent of horizon.

The rates of return for the 42 contracts show strong systematic (nondiversifiable) risk with respect to the commodity futures index, but in general only nonsystematic (diversifiable) risk with respect to the stock index. Hence, commodity futures permit for a stockholder reduction of risk through diversification. For the commodities investor, such risk diversification can come only through investing in gold or Treasury bill futures. In general, individual stock investors seeking risk reduction would have found the addition of commodity futures to their portfolio attractive. This set of results would be magnified if futures positions had been leveraged in the analysis. However, whether the investor should be on the short or long side of the market is a matter of forecast analysis and beyond the scope of this paper.

Further work needs to be done analyzing why the divergent results exist between the two indexes. The security market index does not appear to be a good proxy for a capital market index, especially in the study of commodities. A composite wealth index is needed. It may also be that industry rather than general market factors influence the pattern of interrationships among commodity futures market returns. Industry factors may be highly correlated with returns ex post. It remains to be explored how futures relates to general equilibrium pricing conditions.

To investigate the appropriateness of the CAPM in studying returns, we regressed cross-sectionally mean returns against the individual betas for each horizon. Expecting positive relationships between mean returns and nondiversifiable risks, we found only one of 28 relationships significant. However, there was a significant relationship between the mean returns and standard deviation in 11 out of 14 cases. Thus, there may

be a slight risk premium in a total market sense, but not necessarily from normal backwardation. Further work is needed on the use of CAPM in commodity futures. Nevertheless, this work must account for horizon which we found to be important.

Finally, the fact that commodity futures contracts have limits in their daily price moves suggests that truncated distribution techniques of analysis may be appropriate and sensitive. Another important area of research would be the impact of inflation on the futures contracts and risk-return relationships over alternative horizons and against alternative indexes. The existence of a risk premium in commodity futures contracts needs more careful analysis to distinguish between different measures of risk. Besides the standard deviation and beta coefficient, semi-variance and mean absolute deviation can also be used as risk proxies (Stone). Further investigation is also needed on the impact of autocorrelation on the moments of the distribution and risk (premium) estimates.

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